PB82-233651

Energy Impact Assessment for Alternative Levels of the National Ambient Air Quality Standard for Ozone (Draft)

(U.S.) Environmental Protection Agency
Research Triangle Park, NC

Jun 78

U.S. Department of Commerce
National Technical Information Service
NTIS

PB82-233651

ENERGY IMPACT ASSESSMENT FOR ALTERNATIVE LEVELS OF THE NATIONAL AMBIENT AIR QUALITY STANDARD FOR OZONE

Strategies and Air Standards Division
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

DRAFT

June 1978

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA 22161

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
		PB82 233651

4. TITLE AND SUBTITLE

Energy Impact Assessment for Alternative Levels of the National Ambient Air Quality Standard for Ozone: Draft

5. REPORT DATE

June 1978

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS

10. PROGRAM ELEMENT NO.

11. CONTRACT/GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS

Strategies and Air Standards Division
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

13. TYPE OF REPORT AND PERIOD COVERED

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This document outlines the energy impact on each of the four alternative air quality standards for ozone. The cost estimates are based on the least-cost control strategy for each source evaluated. Recently completed studies on energy impacts associated with asphalt paving, gasoline marketing, automobile and light truck body painting operation, and petroleum refining form the principal data base on energy impacts used in this study. The estimates of the overall impacts are based on 90 non-attainment Air Quality Control Regions and on the impact associated with specific control strategies. TABLES.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Quality Standards Air Pollution Ozone Energy		EPA 68A

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
	20. SECURITY CLASS *(This page)*	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

ENERGY IMPACT ASSESSMENT FOR ALTERNATIVE LEVELS OF THE NATIONAL AMBIENT AIR QUALITY STANDARD FOR OZONE

Control costs presented in a companion document, Cost and Economic Impact Assessment for Alternative Levels of the National Ambient Air Quality Standard for Ozone[1] show the costs due to hydrocarbon control needed to attain alternative ozone air quality standards (0.08 ppm, 0.10 ppm, 0.12 ppm and 0.14 ppm). The overall cost estimates presented in the companion document are developed based on selecting the least-cost control strategy for each source category evaluated. The same least-cost control strategy and the same data base are used in this document for estimating the energy impact for the same four alternative air quality standards for ozone.

The energy requirements for the selected control strategy depend upon the rate of emissions, the concentration of the effluent stream, and the specific arrangement of equipment and process.[2] For some industries, substitution of water-based materials for photochemically reactive materials or process changes that reduce or eliminate vapor emissions prove to be the least cost strategy.[2] Process changes may also include measures such as good housekeeping practices and electrostatic sprays to reduce or eliminate solvent emissions. Recently completed studies on energy impacts associated with asphalt paving,[3] gasoline marketing,[4] automobile and light duty truck body painting operations,[5] and petroleum refining[6] formed the principal data base on energy impacts used in this study.

Where data on energy impacts were not available, energy impacts associated with similar processes were assumed. For example, energy impacts associated with control measures in the fabric finishing industry were assumed to be similar to those in other coating industries.

As in the companion document, estimates of the overall impacts are based upon 90 non-attainment Air Quality Control Regions (AQCRs) and upon the impact associated with specific control strategies. The energy impact of the least-cost control strategy in a specific industry is considered first. Industries with similar operations are aggregated then into larger subsets. The contribution of each type source is obtained so that the energy impact (Btu/lb emission controlled) for individual source categories can be calculated. The total energy impact (Btu/yr) is then calculated using 1987 emissions projections. These 1987 emission projections are derived from the same data base that was used in the companion document.[1] The emission projections are associated with ozone standards of 0.08 ppm, 0.10 ppm, 0.12 ppm and 0.14 ppm, which may or may not be achieved by RACT (reasonably available control technology). In a given situation, for example, the application of RACT could result in ozone levels being reduced to 0.10 ppm rather than 0.08 ppm. In other situations, RACT could reduce ozone levels to 0.04 ppm for the same target of 0.08 ppm. In this case, only that amount of control required to achieve 0.08 ppm would be applied.

Tables 1 through 7 present the energy impact estimates for least-cost control measures for a number of industries. These industries are the basic components that are aggregated into larger source categories which contain similar operations from different industries.

The energy impacts are calculated on the basis of (1) the heating value of the hydrocarbon, (2) the process energy used to produce or refine the hydrocarbon[7] and (3) the energy needed to operate a control device. The energy associated with the production and installation of control equipment is not included. The energy impacts of control measures are representative values that do not take into account facility geographic location, size or capacity. There may be differences of about 50% or so in our estimates for the rubber industry and the surface coating industry. Where such variations were observed in available information, the higher energy consumption values or the lower energy conservation values were selected. The data from Tables 1 through 7 are combined to form the energy impact in Btu/lb for each of the non-vehicle source categories for RACT as shown in Table 8. This table is an aggregate of data obtained from Tables 1 through 7. In addition to the uncertainties just mentioned, other uncertainties about energy impacts appear here because the following assumptions are made:

(1) The contribution of each component is based upon the amount of emissions contained in the National Emissions Data System (NEDS) data bank. NEDS accounts for about one-half of total national hydrocarbon emissions.

(2) The aggregates for Petroleum Industries and Chemical Manufacturing are based upon estimates which do not include the contribution of each component. It is believed the estimates are reasonable, although they can vary significantly with season, geography and specific facility.

Data for vehicle source categories were obtained from OAQPS technical staff.[8] The distribution of annual hydrocarbon emissions for 1987 among the source categories for 90 non-attainment AQCRs is shown in Tables 9 and 10 where RACT is applied in an attempt to reach alternative ozone concentrations of 0.08, 0.10, 0.12, and 0.14 ppm. Table 9 shows a high growth projection while Table 10 shows a low growth projection. Estimates of the energy impacts associated with applying RACT to each source category are given in Tables 11 and 12, which correspond to Tables 9 and 10 respectively. As can be seen in Tables 9 through 12, two values are shown for each standard. One value results from using the Rollback Model to relate emission reductions with air quality and the other value results from using the Empirical Kinetic Modeling Approach (EKMA). The values are similar for both models. As can be seen in Tables 11 and 12, energy savings increase as the target standard decreases. The savings occur because the recovery of hydrocarbons that would otherwise be emitted to the atmosphere results in an energy credit when the heating value of the recovered hydrocarbon (about 20,000 Btu/lb) exceeds the energy required to operate the control device. Thus, the greater the reduction in emissions, the greater are the savings.

In order to achieve the alternative standards, emissions in many areas must be reduced beyond what may be possible through the existing RACT.[1] Since data were not available on energy impacts beyond RACT, it was assumed that application of the additional controls would result in neither energy savings nor losses. Therefore, the energy impacts shown in Tables 11 and 12 for applying RACT in the 90 non-attainment AQCRs are assumed to be

equal to the energy impact for achieving the standards. Since applying RACT results in energy savings in all situations, going beyond RACT would probably also result in some savings; however, no savings were assumed.

Tables 11 and 12 show that the energy savings range from about 1.7×10^{14} Btu/year for the 0.08 ppm standard (high growth rate) to about 1.0×10^{14} Btu/year for the 0.14 ppm standard (low growth rate). Since one ton of coal has a heating value of about 22×10^{6} Btu, these savings are equivalent to about 7.7×10^{6} to 4.5×10^{6} tons of coal per year. More to the point, the energy savings are equivalent to about 57×10^{6} to 33×10^{6} barrels/year of crude oil, the basis of most hydrocarbons. Thus, the emission reduction is accompanied by significant savings in energy and crude oil.

LIST OF REFERENCES

1. "Cost and Economic Impact Assessment for Alternative Levels of the National Ambient Air Quality Standard for Ozone," U.S. Environmental Protection Agency, June, 1978.

2. "Control Techniques for Volatile Organic Emissions From Stationary Sources," Radian Corporation, Austin, Texas, 1977 pp. 4-7 (EPA Contract No. 68-02-2608).

3. "Air Quality and Energy Conservation Benefits from Using Emulsions to Replace Asphalt Cutbacks in Certain Paving Operations," U.S. Environmental Protection Agency, Research Triangle Park, N. C., January, 1978, EPA-450/2-78-004.

4. Internal correspondence to Dr. R. Angus, Pollutant Strategies Branch, SASD, OAQPS, July 25, 1977.

5. "The Energy Impact of Air Pollution Controls in the Finishing of Light Duty Truck and Automobile Bodies, C. J. Maday, 84th Annual AICHE Meeting, February 28, 1978, Atlanta, Georgia.

6. "Energy Penalties Associated with Environmental Regulations in Petroleum Refining," Volume. I, Radian Corporation, Report No. 11-134-02, April 27, 1977.

7. "The Data Base, The Potential for Energy Conservation in Nine Selected Industries," Office of Industrial Programs, Federal Energy Administration, Table 5.4.

8. "Changes in the Energy Impact of I & M", internal memorandum from B. Jordan to J. McGinnity, June 21, 1978.

Table 1. ENERGY IMPACT OF CONTROL MEASURES FOR OIL AND GAS PRODUCTION, REFINING, AND STORAGE

Source/Affected Operation	Facility Size	Control Efficiency %	Energy Impact (Btu/lb HC Controlled)	Control Measure	Reference[3]
1. Oil and gas production		NA[1]	(20,000)[2]	Detection and maintenance	1, p. 30
2. Petroleum Refineries					
		91	2000	- Detection and maintenance	1, p. 17-18
				- Mechanical Seals	1,2, table 7.3-1
				- Flare Header System	
				- Floating roof covers	
				- Floating roof covers	
				- Detection and maintenance	
		99	N/A[4]	- Incineration of non-condensables	
		97	N/A	- Combust non-condensable vapors	
3. Storage of crude oil and gasoline	250,000 bbl.	97	(20,000)	- Secondary seal on floating roof tank	1, p. 2
4. Natural gas and natural gasoline processing plants		91	(20,000)	- Covers for oil-water separators	1, p. 27
				- Mechanical seals	
				- Detection and maintenance	

[1] N.A. = not available.

[2] Parentheses indicate energy savings.

[3] These references cover Facility Size, Control Efficiency, and Control Measure. Energy impact data are found in prior set of references listed after expository text.

[4] Not Available

Table 2. ENERGY IMPACT OF CONTROL MEASURES FOR SELECTED GASOLINE HANDLING AND DISTRIBUTION OPERATIONS

Source/Affected Operation	Facility Size	Control Efficiency %	Energy Impact (Btu/lb HC Controlled)	Control Measure	Reference[4]
1. Marine Terminals	10^7 bbl/day	95	(20,000)[3]	Refrigeration/ absorption	2, p. 142
2. Gasoline Bulk Terminals					
- Top Splash Fill	250,000 gpd	94	(18,000)	Refrigeration	3, p. 4-4
	500,000 gpd	94	(18,000)	Refrigeration	
- Top Submerged Fill and Bottom Fill	250,000 gpd	87	(18,000)	Refrigeration	
	500,000 gpd	87	(18,000)	Refrigeration	
3. Gasoline Bulk Plants					
- Top Splash Fill	5,000 gpd	58	(19,000)	Conversion to top-submerged fill	4, p. 4-3
		93	(19,000)	Vapor Balance	
	20,000 gpd	58	(19,000)	Conversion to top-submerged fill	
		93	(19,000)	Vapor balance	
- Top-submerged Fill and Bottom Fill	5,000 gpd	93	(20,000)	Vapor balance	
	20,000 gpd	93	(20,000)	Vapor balance	
4. Service Stations					
- Underground tanks (Stage I)	3 tanks	93	(20,000)	Vapor balance	5
- Underground tanks and vehicle refueling (Stages I and II)	20,000 gpm 3 pumps	90	(20,000)	Vapor Collection System[1,2]	5
	60,000 gpm 9 pumps	90	(20,000)		
	120,000 gpm 12 pumps	90	(20,000)		
5. Gasoline tank trucks		99	(20,000)		1, p. 15

[1]Three technologies (no latch/no flow balance, hydrid aspirator assist, and vacuum assist) appear capable of achieving greater than 90 percent control.

[2]Underground tanks controlled with vapor balance system.

[3]Parentheses indicate energy savings.

[4]These references cover Facility Size, Control Efficiency, and Control Measure. Energy impact data are found in prior set of references listed after expository text.

Table 3. ENERGY IMPACT OF CONTROL MEASURES FOR SELECTED SURFACE COATING OPERATIONS

Source/Affected Operation	Facility Size	Control Efficiency %	Energy Input (Btu/lb HC Controlled)	Control Measure	Reference [3]
1. Automobile and light duty truck assembly					
- Primer application area	123×10^3 scfm	93%	5000	Electrophoretic application of primer	6, p. 6-21
- Primer curing oven	1.6×10^3 scfm				
- Topcoat application area	248×10^3 scfm	85%	(13,000)[2]	· Carbon adsorption [1]	6, p. 6-28
		95%	6000	· Thermal incineration	6, p. 6-32
	1815×10^3 scfm	85%	(13,000)	· Carbon adsorption	6, p. 6-28
		95%	8000	· Thermal incineration	6, p. 6-32
- Topcoat curing oven	3.4×10^3 scfm	95%	8000	· Thermal incineration	6, p. 6-34
	25×10^3 scfm	95%	8000	· Thermal incineration	6, p. 6-34
2. Can Coating	5.0×10^3 scfm	90%	(13,000)	· Carbon adsorption	6, p. 2-31
		95%	8000	· Thermal incineration	6, p. 2-23
	15×10^3 scfm	90%	(13,000)	· Carbon adsorption	6, p. 2-31
		95%	8000	· Thermal incineration	6, p. 2-23
3. Coil Coating					
- Coaters, ovens, quench areas	15×10^3 scfm	95%	8000	· Thermal incineration	6, p. 3-18
4. Fabric Coating					
- Application area and drying oven	15×10^3 scfm	90%	(13,000)	· Carbon adsorption	6, p. 4-17
		95%	8000	· Thermal incineration	6, p. 4-14
5. Paper coating	15×10^3 scfm	90%	(13,000)	· Carbon adsorption	6, p. 5-25
		95%	8000	· Thermal incineration	6, p. 5-22
6. Magnet wire coating	15×10^3 scfm	95%	8000	· Thermal incineration	6, p. 3-18 1, p. 68
7. Large appliances					
- Application areas	50×10^3 scfm	80%	(13,000)	· Carbon adsorption	1, p. 65
- Ovens	15×10^3 scfm	80%	8000	· Thermal incineration	1, p. 65

[1] Includes credit for primary heat recovery.

[2] Parentheses indicate energy savings.

[3] These references cover Facility Size, Control Efficiency, and Control Measure. Energy impact data are found in prior set of references listed after expository text.

Table 4. ENERGY IMPACT OF CONTROL MEASURES FOR SELECTED GRAPHIC ARTS PROCESSES

Source/Affected Operation	Facility Size	Control Efficiency %	Energy Input (Btu/lb HC Controlled)	Control Measure	Reference [2]
1. Webb Offset Printing	5000 scfm	95	8000	Direct Flame incinerator	1, p. 45
		90	(13,000) [1]	Carbon adsorption	
	20,000 scfm	95	8000	Direct flame incinerator	
		90	(13,000)	Carbon adsorption	
2. Flexographic Printing	5000 scfm	95	8000	Direct flame incinerator	1, p. 52
	20,000 scfm	95	8000	Direct flame incinerator	
3. Rotogravure printing	5000 scfm	95	8000	D.F. incinerator	1, p. 43
		90	(13,000)	Carbon adsorption	
	20,000 scfm	95	8000	D.F. incinerator	
		90	(13,000)	Carbon adsorption	
4. Webb Letterpress printing	5000 scfm	95	8000	D.F. incinerator	1, p. 48
		90	(13,000)	Carbon adsorption	
	20,000 scfm	95	8000	D.F. incinerator	
		90	(13,000)	Carbon adsorption	

[1] Parentheses indicates energy savings.

[2] These references cover Facility Size, Control Efficiency, and Control Measure. Energy impact data are found in prior set of references listed after expository text.

Table 5. ENERGY IMPACT OF CONTROL MEASURES FOR SELECTED SOURCES OF EVAPORATIVE HYDROCARBON EMISSIONS

Source/Affected Operation	Facility Size	Control Efficiency %	Energy Input (Btu/lb HC Controlled)	Control Measure	Reference [2]
1. Organic solvent metal cleaning operations					
- Cold Cleaners					
Low volatility solvent		15%	(13,000)[1]	Drainage facility	7, p. 4-7
High volatility solvent		30%	(14,000)	Drainage facility with mechanically assisted cover.	
- Open top vapor degreasers	Typical	30	(13,000)	Manual cover	7, p. 4-11
		45	(13,000)	Refrigerated chiller	
		97	(14,000)	Enclosed design	
- Conveyorized degreasers	Typical				
Monorail		50	(19,000)	Refrigerated chiller	7, p. 4-17
Cross-Rod		50	(19,000)	Refrigerated chiller	
2. Dry cleaning Operations					
- Petroleum plants					
•Neighborhood cleaners dryer, still, misc.		80	(13,000)	Carbon adsorption	8, p. 48
Filter Muck		90	(13,000)	Centrifugal separator	
TOTAL					
•Industrial plant					
Dryer, Still, Misc.		80	(13,000)	Carbon adsorption	8, p. 4-10
Filter Muck		90	(13,000)	Centrifugal separator	
TOTAL					
- Perchloroethylene plants					
•Coin-op facility		66	(13,000)	Carbon adsorption	8, p. 4-18
•Commercial plant		55	(13,000)	Carbon adsorption	
•Industrial plant		51	(13,000)	Carbon adsorption	
3. Cutback asphalt paving		99	(33,500)	Substitution of emulsified asphalt	1, p. 32

[1]Parentheses indicates energy savings.

[2]These references cover Facility Size, Control Efficiency, and Control Measure. Energy impact data are found in prior set of references listed after expository text.

Table 6. ENERGY IMPACT OF CONTROL MEASURES FOR RUBBER PRODUCT MANUFACTURE

Source/Affected Operation	Facility Size	Control Efficiency %	Energy Input (Btu/lb HC Controlled)	Control Measure	Reference [1]
1. Synthetic Elastomers					
- Tank Farm	20,000 gal	80	N/A[2]	Floating covers	9, p. 4.1.3
- Recovery area	1,000 scfm	90	1600	Adsorption	9, p. 4.4.3
- Finishing area	15,000 scfm	90	44,000	Thermal incineration	9, p. 4.6.4
2. Tires and Inner Tubes					
- Fabric cementing	5,000 scfm	80	81,000	Adsorption	9, p. 4.14.3
		90	N/A	Incineration	
- Green tire spraying	15,000 scfm	80	22,000	Adsorption	9, p. 4.13.3 (Table 12)
		90	N/A	Thermal incineration	
- Curing operations	25,000 scfm	90	1,700,000	Thermal incineration	9, p. 4.10.3
- Undertread cementing	5,000 scfm	90	40,000	Incineration	9, 4.12.2
3. Rubber Footwear					
- Rubber Cementing (Adhesive spraying)	1,000 scfm	90	1600	Adsorption	9, p. 4.16.2
- Molding operations	25,000 scfm	90	N/A	Thermal incineration	9, p. 4.10.3 (Table 9)
4. Reclamatory processes	1,500 scfm	90	N/A	Absorption: condenser and scrubber	9, p. 4.19.2
5. Rubber Hose and Belting					
- Fabric Cementing	5,000 scfm	90	40,000	Thermal incineration	9, p. 4.14.3
6. Fabricated Rubber Goods					
- Molding	25,000 scfm	90	N/A	Thermal incineration	9, p. 4.10.3
- Curing	25,000 scfm	90	1,700,000	Thermal incineration	9, p. 4.10.3
- Adhesive spraying	1,000 scfm	90	N/A	Adsorption	9, p. 4.16.2
7. Gaskets, Packing, Sealing					
- Molding	25,000 scfm	90	N/A	Thermal incineration	9, p. 4.10.3
- Adhesive spraying	1,000 scfm	90	N/A	Adsorption	9, p. 4.12.2
8. Nonferrous Wiredrawing					
- Curing	25,000 scfm	90	1,700,000	Thermal incineration	9, p. 4.10.3
9. Tire Retreading					
- Rubber cementing	1,000 scfm	90	N/A	Adsorption	9, p. 4.16.2
- Curing	25,000 scfm	90	1,700,000	Thermal incineration	9, p. 4.10.3
10. Shoe Manufacturing					
- Sole attachment operation	1500 pr. shoes per day	90		Hot melt adhesives	10, p. 6
	4500 pr. shoes per day	90	1,700,000	Hot melt adhesives	10, p. 8
	10,500 pr shoes per day	90		Hot melt adhesives	10, p. 10

[1] These references cover Facility Size, Control Efficiency, and Control Measure. Energy impact data are found in prior set of references listed after expository text.

[2] Not Available

Table 7. ENERGY IMPACT OF CONTROL MEASURES FOR SELECTED CHEMICAL MANUFACTURING PROCESSES

Source/Affected Operation	Facility Size	Control Efficiency %	Energy Input (Btu/lb HC Controlled)	Control Measure	Reference [2]
1. Ethylene Dichloride (oxychlorination)	350 x 10^3 TPY	97	N/A[3]	Thermal incinerator, waste boiler and caustic scrubbing	11, Vol. 3 pp. ED-39-40
		97	500	Thermal incinerator and caustic scrubbing	
2. Acrylonitrile	100 x 10^3 TPY	99	8800	Thermal incinerator and waste heat boiler	11, Vol. 2, pp. AN-32
		99	N/A	Thermal incinerator	
3. Ethylene Oxide					
- Air oxidation plant	100 x 10^3 TPY	85	6400	Catalytic incineration	11, Vol. 6, pp. EO-31-32
- Oxygen oxidation plant	100 x 10^3 TPY	85	N/A	Steam generator	
		85	N/A	Thermal incineration	
4. Formaldehyde					
- Silver catalyst	50 x 10^3 TPY	80	490	Boiler house vent gas burner	11, Vol. 4, p. FS-33
		80	610	Thermal incinerator	
- Mixed oxide catalyst[1]	50 x 10^3 TPY	93	1460	Thermal incinerator	11, Vol. 5, p. FM-25
		93	1720	Thermal incinerator	

[1]Does not include recycling.

[2]These references cover Facility Size, Control Efficiency, and Control Measure. Energy impact data are found in prior set of references listed after expository text.

[3]Not Available

TABLE 8

Energy Impact for Each Pound Hydrocarbon Controlled
For Standard Source Categories With RACT

Source Category	Energy Impact Btu/lb
Light Duty Vehicles	0
Other Highway Vehicles	0
Non-Highway Vehicles	–
Oil and Gasoline Marketing	(19,000)
Fuel Combustion	–
Chemical Manufacturing	5,000
Petroleum Industries	2,000
Other Industrial Processes	–
Solvent Evaporation	(7,000)[1]
Solid Waste	–
Miscellaneous	–

Note: Parentheses indicates energy savings.

[1]The savings associated with emulsified asphalts and gasoline and crude oil storage are responsible for the energy credit in the solvent evaporation category. The heating value of the hydrocarbon is the contributing factor.

TABLE 9

Distribution of Annual Hydrocarbon Emissions Among Source Categories for 90 Nonattainment AQCR's Under Alternative Ozone Target Standards[1]

Source Category	1987 Emissions w/o RACT, w/o NSPS, w/FMVCP 10^6 tons	1987 Emissions w/RACT and With New and Modified Source Control							
		0.08ppm Target[2]		0.10ppm Target		0.12ppm Target		0.14ppm Target	
		R-B[3]	EKMA	R-B	EKMA	R-B	EKMA	R-B	EKMA
		10^6 tons		10^6 tons		10^6 tons		10^6 tons	
Light-Duty Vehicles	2.06	1.39	1.31	1.59	1.35	1.76	1.52	1.84	1.63
Other Highway Vehicles	0.65	0.62	0.62	0.63	0.62	0.64	0.63	0.64	0.63
Non-Highway Vehicles	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Oil and Gasoline Marketing	1.13	0.19	0.14	0.41	0.17	0.65	0.36	0.79	0.48
Fuel Combustion	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Chemical Manufacturing	0.87	0.21	0.21	0.21	0.21	0.29	0.22	0.32	0.24
Petroleum Industries	0.61	0.04	0.04	0.04	0.04	0.05	0.04	0.17	0.05
Other Industrial Processes	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Solvent and Petroleum Evaporation	15.6	5.52	5.51	5.79	5.53	6.21	5.79	6.60	5.98
Solid Waste	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Miscellaneous	0.07	0.07	.07	0.07	.07	0.07	.07	0.07	0.07
Total	22.97	10.02	9.88	10.72	9.97	11.65	10.61	12.41	11.06

[1] "Alternative Air Quality Standards for Ozone: Implications for Hydrocarbon Control Costs", D.L. Keyes, Energy and Environmental Analysis, Inc., EPA Contract Nos. 68-02-2807 and 68-01-4101.

[2] This is target, not standard. RACT is applied until target is achieved, if at all, and not exceeded.

[3] Rollback

[4] Empirical Kinetic Modeling Approach.

Assumptions:
High Growth Base or Average RACT 0.02 ppm Background

TABLE 10

Distribution of Annual Hydrocarbon Emissions Among Source Categories for 90 Nonattainment AQCR's Under Alternative Ozone Target Standards[1]

Source Category	1987 Emissions w/o RACT, w/o NSPS, w/FMVCP 10^6 tons	1987 Emissions w/RACT and With New and Modified Source Control							
		0.08ppm Target[2]		0.10ppm Target		0.12ppm Target		0.14ppm Target	
		R-B	EKMA	R-B	EKMA	R-B	EKMA	R-B	EKMA
		10^6 tons		10^6 tons		10^6 tons		10^6 tons	
Light-Duty Vehicles	1.80	1.38	1.14	1.57	1.28	1.69	1.53	1.74	1.57
Other Highway Vehicles	0.58	0.58	0.55	0.58	0.56	0.58	0.57	0.58	0.58
Non-Highway Vehicles	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
Oil and Gasoline Marketing	1.0	0.14	0.13	0.31	0.15	0.53	0.28	0.65	0.39
Fuel Combustion	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Chemical Manufacturing	0.69	0.18	0.18	0.19	0.18	0.28	0.19	0.29	0.22
Petroleum Industries	0.53	0.03	0.03	0.04	0.03	0.10	0.04	0.20	0.05
Other Industrial Processes	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Solvent and Petroleum Evaporation	12.38	3.83	3.37	4.75	3.64	5.42	4.50	6.04	4.88
Solid Waste	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Miscellaneous	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Total	18.84	7.99	7.25	9.29	7.69	10.45	8.96	11.35	9.54

[1] "Alternative Air Quality Standards for Ozone: Implications for Hydrocarbon Control Costs", D.L. Keyes, Energy and Environmental Analysis, Inc., EPA Contract Nos. 68-02-2807 and 68-01-4101

[2] This is target, not standard. RACT is applied until target is achieved, if at all, and not exceeded.

[3] Rollback

[4] Empirical Kinetic Modeling Approach.

Assumptions:

Low Growth Advanced RACT 0.02 ppm Background

TABLE 11

Annual Energy Impacts of Control Measures Applied to 90 Non-attainment AQCRs 1987 Emissions w/RACT and w/NSPS

RACT APPLIED IN ATTEMPT TO REACH STANDARD

Source Category	0.08ppm		0.10ppm		0.12ppm		0.14ppm	
	R-B	EKMA	R-B	EKMA	R-B	EKMA	R-B	EKMA
	10^{14} Btu		10^{14} Btu		10^{14} Btu		10^{14} Btu	
Light-Duty Vehicles	–	–	–	–	–	–	–	–
Other Highway Vehicles	–	–	–	–	–	–	–	–
Non-Highway Vehicles	–	–	–	–	–	–	–	–
Oil and Gasoline Marketing	+0.357	+0.376	+0.274	+0.365	+0.182	+0.293	+0.129	+0.247
Fuel Combustion	–	–	–	–	–	–	–	–
Chemical Manufacturing	-0.066	-0.066	-0.066	-0.066	-0.058	-0.065	-0.055	-0.063
Petroleum Industries	-0.023	-0.023	-0.023	-0.023	-0.022	-0.023	-0.018	-0.022
Other Industrial Processes	–	–	–	–	–	–	–	
Solvent and Petroleum Evaporation	+1.41	+1.41	+1.37	+1.41	+1.31	+1.37	+1.26	+1.35
Solid Waste	–	–	–	–	–	–	–	–
Miscellaneous	–	–	–	–	–	–	–	–
Total	+1.68	+1.70	+1.56	+1.69	+1.41	+1.58	+1.32	+1.51

Footnote:

[1]A '+' sign indicates energy saving; a '-' sign indicates energy consumption.

Assumptions:

High Growth Base or Average RACT 0.02 ppm Background

TABLE 12

Annual Energy Impacts of Control Measures Applied to 90 Non-attainment AQCRs 1987 Emissions w/RACT and w/MSPS

Source Category	RACT APPLIED IN ATTEMPT TO REACH STANDARD							
	0.08ppm		0.10ppm		0.12ppm		0.14ppm	
	R-B	EKMA	R-B	EKMA	R-B	EKMA	R-B	EKMA
	10^{14}Btu		10^{14}Btu		10^{14}Btu		10^{14}Btu	
Light Duty Vehicles	–	–	–	–	–	–	–	–
Other Highway Vehicles	–	–	–	–	–	–	–	–
Non Highway Vehicles	–	–	–	–	–	–	–	–
Oil and Gasoline Marketing	+0.327	+0.331	+0.262	+0.323	+0.179	+0.274	+0.133	+0.232
Fuel Combustion	–	–	–	–	–	–	–	–
Chemical Manufacturing	-0.051	-0.051	-0.050	-0.051	-0.041	-0.050	-0.040	-0.047
Petroleum Industries	-0.020	-0.020	-0.020	-0.020	-0.017	-0.020	-0.013	-0.019
Other Industrial Processes	–	–	–	–	–	–	–	–
Solvent and Petroleum Evaporation	+1.20	+1.26	+1.07	+1.22	+0.97	+1.10	+0.89	+1.05
Solid Waste	–	–	–	–	–	–	–	–
Miscellaneous	–	–	–	–	–	–	–	–
Total	+1.46	+1.52	+1.26	+1.47	+1.09	+1.30	+0.97	+1.22

Footnote:

[1] A '+' sign indicates energy saving; a '-' sign indicates energy consumption

Assumptions:

Low Growth Advanced RACT 0.02 ppm Background

References for

Tables 1 through 7

1. "Air Pollution Control Technology Applicable to 26 sources of Volatile Organic Compounds", Office of Air Quality Planning Standards, U.S. Environmental Protection Agency, May 27, 1977.

2. Radian Corporation, "Background Information on Hydrocarbon Emissions from Marine Terminal Operations", Vol. I, EPA-450/3-76-038, November, 1976.

3. "Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals", Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, May, 1977, Draft.

4. "Control of Volatile Organic Emissions from Gasoline Bulk Plants", guideline document in preparation by Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency.

5. Based on internal EPA analysis of comments submitted in response to November 1, 1976, Federal Register notice concerning the proposal of State II vapor recovery regulations.

6. "Control of Volatile Organic Emissions from Existing Stationary Sources--Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks", Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, EPA-450/2-77-008, May, 1977.

7. "Control of Volatile Organic Emissions from Organic Solvent Metal Cleaning Operations", Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, April, 1977, Draft.

8. "Control of Volatile Organic Emissions from Dry Cleaning Operations", Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, April, 1977, Draft.

9. Monsanto Research Corporation, "Identification and Control of Hydrocarbon Emissions from Rubber Processing Operations", EPA Contract No. 68-02-1411, Task 17, March, 1977.

10. "Control of Organic Solvent Emissions from Adhesive Usage During Shoe Manufacture", guideline document in preparation by Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency.

11. Air Products and Chemicals, Inc., "Engineering and Cost Study of Air Pollution Control for the Petrochemical INdustry", Volumes 2-6, EPA-450/3-73-006.

12. "Energy Penalties Associated with Environmental Regulations in Petroleum Refining", Vol. I: Discussion RADIAN Corporation, EPA Project No. 68-01-4128-2, April 27, 1977.